MULTIMEDIA UNIVERSITY

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

# FINAL EXAMINATION

**TRIMESTER 1, 2015/2016**

## ECP3086 – MULTIMEDIA TECHNOLOGY AND APPLICATIONS

(RE and BE)

8 OCTOBER 2015
2.30 p.m - 4.30 p.m
( 2 Hours )

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**INSTRUCTIONS TO STUDENTS**

1. This question paper consists of 6 pages excluding cover page with 4 questions only.

2. Answer **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the answer Booklet provided.

## Question 1

(a) Identify 5 (FIVE) benefits of data compression. [5 marks]

(b) Construct the HTML codes as **Figure 1** below: (image: lhlee.jpg)

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**Figure 1** [10 marks]

(c) The following string contains the symbol [L, E, Z, H, Y] is to be compressed.

LEEZHEEYEE

(i) Use Huffman coding method to encode the symbols into an optimum variable length code [6 marks]
(ii) Compute the average number of bits per codeword [1 mark]
(iii) Calculate the Entropy of the source [1 mark]
(iv) Calculate the efficiency of the above coding scheme [1 mark]
(v) Compute the minimum number of bits required for each codeword if fixed length coding is used [1 mark]

**Continued .....**

**Question 2**

(a) The following image in **Figure 2.1** will be used to perform image compression and decompression using the program shown in **Figure 2.2**.

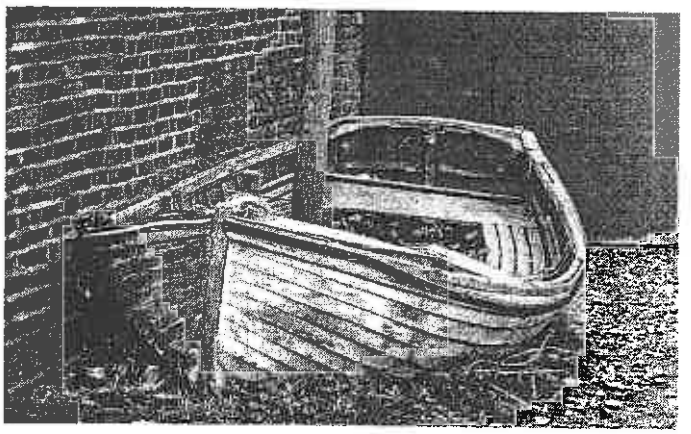

**Figure 2.1**

```
T = dctmtx(8);

Mask=[ 1  1  1  1  1  1  1  1
       1  1  1  1  1  1  1  1
       1  1  1  1  1  1  1  1
       1  1  1  1  1  1  1  1
       1  1  1  1  1  1  1  1
       1  1  1  1  1  1  1  1
       1  1  1  1  1  1  1  1
       1  1  1  1  1  1  1  1 ];
```

Figure 2.2

In order to preserve the image quality. the DCT coefficient is multiplied by 1, else multiplied with 0 to remove the image DCT coefficient.

(i) Analyze the compression ratio achieved if the program in **Figure 2.2** is used to compress the image in **Figure 2.1** [2 marks]

(ii) Is it possible to remove all of the DCT coefficients except for the DC value without affecting the quality of the reconstruct images?
Justify your answer. [3 marks]

(iii) Propose a new code in the program in **Figure 2.2** in order to compress the image while not severely affect the quality of the reconstructed image. [3 marks]

**Continued .....**

**Question 2**

(b) The edges divide the regions of distinct color. Name 3 (THREE) edge detection techniques. [3 marks]

(c) The original image and reconstructed image of a particular compression algorithm are shown in **Figure 2.3** and **Figure 2.4** respectively.
Compute the SNR and PSNR of the reconstructed image. [8 marks]

| | | | |
|---|---|---|---|
| 252 | 41 | 103 | 188 |
| 241 | 45 | 116 | 194 |
| 232 | 235 | 157 | 5 |
| 25 | 202 | 242 | 33 |

**Figure 2.3**

| | | | |
|---|---|---|---|
| 240 | 40 | 113 | 198 |
| 250 | 42 | 123 | 200 |
| 231 | 242 | 160 | 5 |
| 40 | 212 | 250 | 33 |

**Figure 2.4**

(d)

(i) Determine the value of center pixel after mean filtering with window size 3×3 in **Figure 2.5** below. [2 marks]

| | | |
|---|---|---|
| 155 | 145 | 155 |
| 176 | 187 | 165 |
| 187 | 195 | 156 |

**Figure 2.5**

**Continued .....**

(ii) Determine the center pixel value after filtering process using the Laplacian filter of **Figure 2.6**. [2 marks]

| | | |
|---|---|---|
| -1 | -1 | -1 |
| -1 | 8 | -1 |
| -1 | -1 | -1 |

**Figure 2.6**

(iii) Apply symmetric padding and use the median filter to find the output value of pixel (1, 2) in **Figure 2.5**. [2 marks]

**Question 3**

(a) Mention 2 (TWO) major differences between the PCM and the Mpeg audio encoding method. [4 marks]

(b) **Figure 3.1** shows the audible threshold graph of human hearing. Justify your answers with reason either detectable or not detectable by human hearing with the following signals.

i) 100 Hz , 15 decibels [2 marks]

ii) 200 Hz. 20 decibels [2 marks]

iii) 1000 Hz. 10 decibels [2 marks]

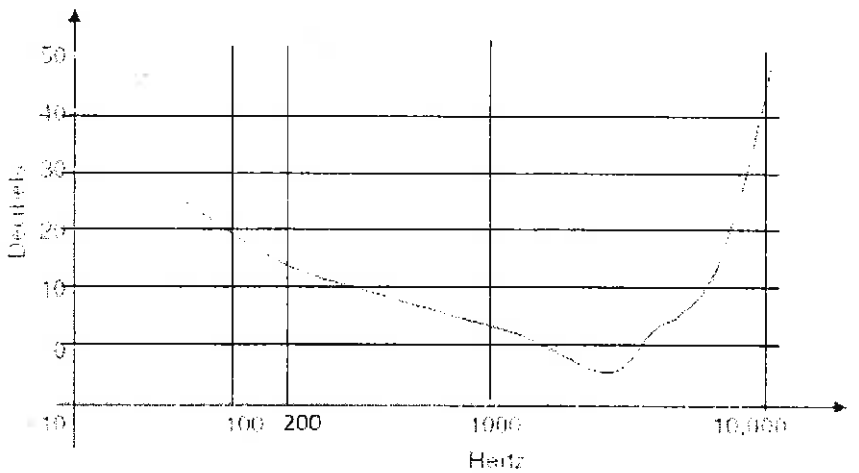


**Figure 3.1 : Audible Threshold Graph**

**Continued .....**

(c) Based on the observation of **Figure 3.1**, rank the following audio tone in a reducing order of human hearing sensitivity. The tones are 100 Hz, 200 Hz, 1000 Hz, 10000 Hz. Use the following arrow and label in your answer. Based on this result, suggest a strategy to allocate the number of bits for the tones in order to reduce quantized data size. [4 marks]



(Most sensitive) (Least sensitive)

Reducing sensitivity order

(d) Dynamic range is the ratio of maximum to minimum absolute values of the signal (in dB) given as below:

$$DR = 20\log_{10}\frac{V_{max}}{V_{min}}$$

$V_{min}$ equals to the quantization step-size, given by:

$$\Delta V = \frac{V_{max}}{2^{N-1}}$$

Given the dynamic range of a signal is 50dB and the required quantization noise is at least 20 times smaller than Vmin (smallest detectable signal). Justify your answer whether 16 bits or 12 bits (bit depth ) is sufficient for your system design. [5 marks]

(e) An audio recording that is composed of the singer voice mixed with musical sound is to be digitized in stereo format. The singer voice bandwidth ranges from 100Hz to 5KHz while the musical instrument signals bandwidths are from 15Hz to 20 KHz. If we were to digitize the audio signal using Nyquist criterion with 16 bits per sample. calculate the following.

i) What is the bitrate (in bits/sec) produced for the stereophonic sound? [2 marks]
ii) What is the storage needed (in bytes) for a 15 minutes song? [2 marks]
iii) If this song is transferred over UNIFI internet network with bandwidth of 20Mbps, compute the time taken to transfer the data. [2 marks]

**Continued .....**

**Question 4**

(a) Video signals can be organized in three different ways: component video, composite video and S-video.

i) Describe how video signals are organized in each of the ways mentioned above. [3 marks]

ii) Rank the above three types of video signals in terms of video quality. Explain your answer. [7 marks]

(b) A multimedia presentation must be delivered over a network at a rate of 2Mbps. The presentation consists of digitized audio and video. The audio has an average bit rate of 500 Kbps. The digitised video is to be compressed using MPEG-1 standard. Assuming a frame sequence of:

**IBBPBBPBB.....**

and average compression ratios of 10:1 and 20:1 for the I-frame and P-frame respectively, propose the compression ratio required for the B-frame to ensure the desired delivery rate.

Note: There is 10% overheads for the multiplexing and packetisation of the MPEG-1 video. MPEG-1 video has the following parameters: 352x240 active pixels, 30 fps , 4:2:2 color sub-sampling format and 8 bits for color/luminance component.

[8 marks]

(c) Figure 5 below shows the block diagram of a content based image retrieval (CBIR) system. Discuss how the retrieval algorithm helps the user to search for images in a huge image database. Your explanation need to relate to the various processes mentioned in Figure 5. [7 marks]

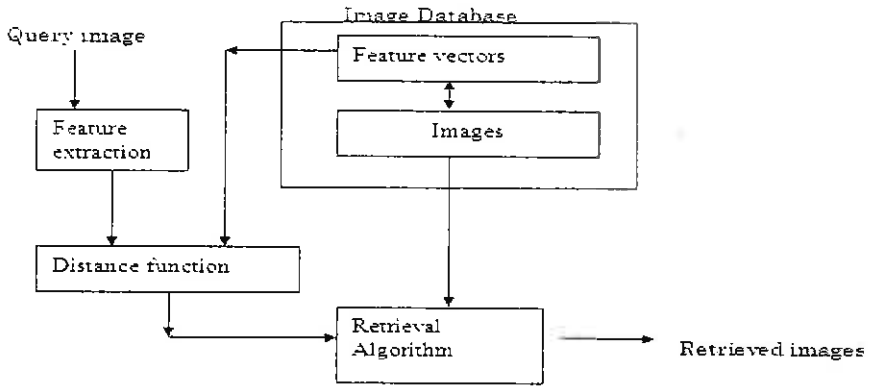


**Figure 5**

**End of Page**